Small Business Innovation Research/Small Business Tech Transfer

Enabling Technology for Thermal Protection on HIAD and Other Hypersonic Missions, Phase II

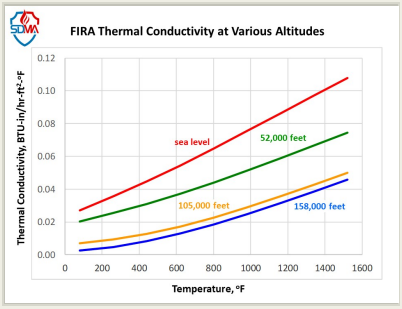
Completed Technology Project (2016 - 2020)

Project Introduction

Gas conduction and radiation are the two important heat transfer mechanisms in highly porous reusable thermal protection systems used for planetary entry of space vehicles. The relative magnitude of the two varies depending on altitude, temperature and the planet. Usually radiation is more significant at lower pressures and at higher temperatures. Gas conduction is more dominant at higher pressures and lower temperatures. In most planetary entries, both modes of heat transfer are significant. Typical flexible or rigid refractory ceramic fiber Thermal Protection System (TPS) such as Advanced Flexible Reusable Surface Insulation (AFRSI) and Shuttle tiles can take high temperatures, can reduce gas conduction at lower pressures, and scatter radiation at higher temperatures. There is a need for more efficient TPS with lower mass, reduced thickness and significantly lower thermal conductivity to make inter planetary missions possible. In order to achieve this goal, insulations need to be developed that can further reduce gas conduction and radiation heat transfer compared to standard refractory ceramic fiber insulations. The overall objective of the Phase II program is to migrate and optimize proven paper making concepts to fabricate robust, flexible and cost efficient, fiber reinforced aerogels, without sacrificing the thermal and mechanical qualities, in large sections suitable for application on High Speed Vehicles (HSV's). Further investigation in Phase II would focus on production methods and recipe optimization for this new class of thermal insulations. Embedding materials with advantageous properties into fibrous mats allows tailoring the temperature and flexibility requirements to meet the needs of specific missions.

Anticipated Benefits

NASA is developing an inflatable thermal protection system known as Hypersonic Inflatable Aerodynamic Decelerator (HIAD). It consists of a giant cone of inner tubes assembled sort of like a child's stacking ring toy may some day help cargo, or even people, land on another planet, return to Earth or any destination with an atmosphere. The HIAD could give NASA more options for future planetary missions, because it could allow spacecraft to carry larger, heavier scientific instruments and other tools for exploration. Improved thermal insulations will play a key role in HIAD and other TPS of the future.According to the Department for Communities and Local Government, 118,760 new homes were built in 2014. This creates a potential market for 320 million square feet of thermal house wrap each year.



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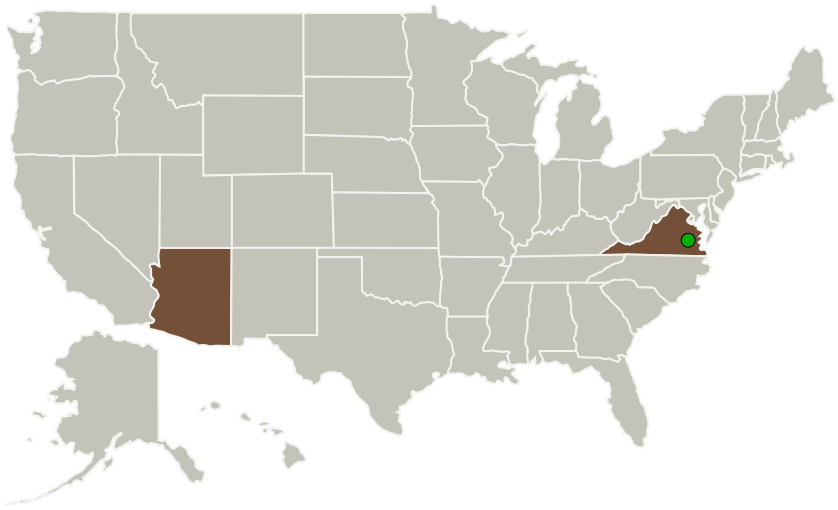
Completed Technology Project (2016 - 2020)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
S. D. Miller and Associates, PLLC	Lead Organization	Industry	Flagstaff, Arizona
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations	
Arizona	Virginia

Project Transitions

May 2016: Project Start

October 2020: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/139460)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

S. D. Miller and Associates, PLLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Project Managers:

Christapher G Lang
Keith L Woodman

Principal Investigator:

Stephen Miller

Enabling Technology for Thermal Protection on HIAD and Other Hypersonic Missions, Phase II

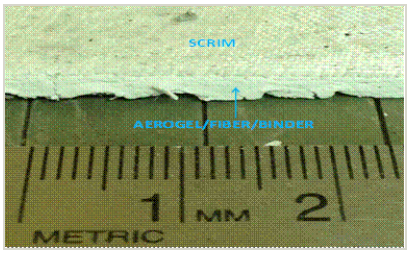
Completed Technology Project (2016 - 2020)

December 2020: Closed out

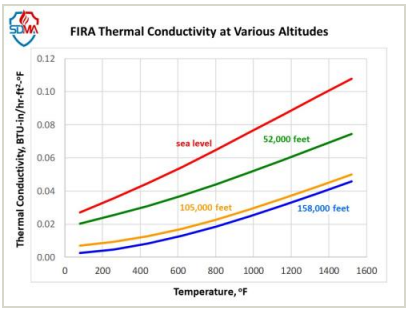
Closeout Documentation:

- Final Summary Chart PDF*(https://techport.nasa.gov/file/139461)*

Images



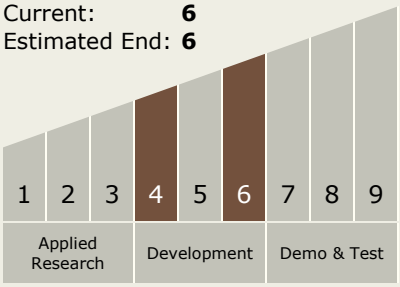
Briefing Chart Image
Enabling Technology for Thermal Protection on HIAD and Other Hypersonic Missions, Phase II *(https://techport.nasa.gov/image/129521)*



Final Summary Chart Image
Enabling Technology for Thermal Protection on HIAD and Other Hypersonic Missions, Phase II *(https://techport.nasa.gov/image/136171)*

Technology Maturity (TRL)

Start: **4**
Current: **6**
Estimated End: **6**



Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System